City of Lynnwood Adaptive Signal Control Technology

System Requirements

7/1/15

Requirements Reference Number	ASCT System Requirements	Need Statement (#.## Represents Relevant Concept of Operations Section)	Meets Requirements	Partially Meets Requirements	Requirement in Development	Requirement Not Available	Briefly discuss how requirement is met and if partially met or in development, how it could be met before the City of Lynnwood Verification	Desirable/ Mandatory
1	**1 Network Characteristics**							
1.0-1	The ASCT shall control a minimum of 29 signals concurrently	4.2.0-1 The system operator needs to eventually adaptively control up to 100 signals (total number of signals that could be added to the system across its 10 year life), up to 15 miles from the TMC.						Mandatory
1.0-2	The ASCT shall support groups of signals.	4.2.0-2 The system operator needs to be able to adaptively control up to 20 independent groups of signals 4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Desirable
1.0-2.0-1	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user.	4.2.0-2 The system operator needs to be able to adaptively control up to 20 independent groups of signals						Desirable
1.0-2.0-2	The ASCT shall control a minimum of 20 groups of signals.	4.2.0-2 The system operator needs to be able to adaptively control up to 20 independent groups of signals						Desirable
1.0-2.0-3	The size of a group shall range from 1 to 49 signals.	4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Mandatory
1.0-2.0-4	Each group shall operate independently	4.2.0-2 The system operator needs to be able to adaptively control up to 20 independent groups of signals						Desirable
1.0-2.0-5	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the ASCT system according to configured parameters.	4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Desirable

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1.0-2.0-5.0-1	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to a time of day schedule. (For example: this may be achieved by assigning signals to different groups or by combining groups.)	4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Desirable
1.0-2.0-5.0-2	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to traffic conditions. (For example: this may be achieved by assigning signals to different groups or by combining groups.)	4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Desirable
1.0-2.0-5.0-3	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system when commanded by the user.	4.2.0-3 The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.						Desirable
2	**2 Type of Operation**							
2.1	**2.1 General**							
2.1.1	**2.1.1 Mode of Operation**							
2.1.1.0-1	The ASCT shall operate non-adaptively during the presence of a defined condition.	4.7.0-1 The system operator needs to detect traffic conditions during which adaptive control is not the preferred operation, and implement some pre-defined operation while that condition is present.						Desirable
2.1.1.0-2	The ASCT shall operate non-adaptively when adaptive control equipment fails.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
2.1.1.0-2.0-1	The ASCT shall operate non-adaptively when a user-specified detector fails.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable

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2.1.1.0-2.0-2	The ASCT shall operate non-adaptively when the number of failed detectors connected to a signal controller exceeds a user-defined value.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
2.1.1.0-2.0-3	The ASCT shall operate non-adaptively when the number of failed detectors in a group exceeds a user-defined value.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable
2.1.1.0-2.0-4	The ASCT shall operate non-adaptively when a user-defined communications link fails.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
2.1.1.0-3	The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptively controlling a group of signals	4.7.0-3 The system operator needs to over-ride adaptive operation.						Mandatory
2.1.1.0-4	The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptive operation.	4.7.0-3 The system operator needs to over-ride adaptive operation.						Mandatory
2.1.1.0-7	The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.1.1.0-7.0-1	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of the signal controllers, maximizing the throughput of the coordinated route.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Mandatory
2.1.1.0-7.0-2	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers, preventing queues from exceeding the storage capacity at user-specified locations.	4.1.0-1.0-4 · Manage the lengths of queues						Mandatory
2.1.1.0-7.0-3	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers providing equitable distribution of green times.	4.1.0-1.0-3 · Distribute phase times in an equitable fashion						Mandatory

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2.1.1.0-7.0-4	When current measured traffic conditions meet user-defined criteria, the ASCT shall alter the state of signal controllers providing two-way progression on a coordinated route.	4.1.0-1.0-2 · Provide smooth flow along coordinated routes						Mandatory
2.1.1.0-9	The ASCT shall detect repeated phases that do not serve all waiting vehicles. (These phase failures may be inferred, such as by detecting repeated max-out.)	4.1.0-4 The system operator needs to detect repeated phase failures and control signal timing to prevent phase failures building up queues.						Desirable
2.1.1.0-9.0-1	The ASCT shall alter operations, to minimize repeated phase failures.	4.1.0-4 The system operator needs to detect repeated phase failures and control signal timing to prevent phase failures building up queues.						Desirable
2.1.1.0-10	The ASCT shall determine the order of phases at a user-specified intersection. (The calculation will be based on the optimization function.)	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.1.1.0-11	The ASCT shall provide coordination along a route.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Mandatory
2.1.1.0-11.0-1	The ASCT shall coordinate along a user-defined route.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Mandatory
2.1.1.0-11.0-2	The ASCT shall determine the coordinated route based on traffic conditions.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Desirable
2.1.1.0-11.0-3	The ASCT shall determine the coordinated route based on a user-defined schedule.	4.1.0-8						Desirable
2.1.1.0-11.0-4	The ASCT shall store 4 user-defined coordination routes.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Desirable
2.1.1.0-11.0-4.0-1	The ASCT shall implement a stored coordinated route by operator command.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Desirable
2.1.1.0-11.0-4.0-2	The ASCT shall implement a stored coordinated route based on traffic conditions.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Desirable

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2.1.1.0-11.0-4.0-3	The ASCT shall implement a stored coordinated route based on a user-defined schedule.	4.1.0-8 The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.						Desirable
2.1.1.0-11.0-5	The ASCT shall not prevent non coordinated phases from being repeated more than once in a single cycle	4.1.0-9 The system operator needs to set signal timing parameters (such as minimum green, maximum green and extension time) to comply with agency policies.						Desirable
2.1.2	**2.1.2 Allowable Phases**							
2.1.2.0-1	The ASCT shall not prevent protected/permissive left turn phase operation.	4.9.0-1.0-14 · Protected/permissive phasing and alternate left turn phase sequences.						Mandatory
2.1.2.0-7	The ASCT shall omit a user-specified phase based on measured traffic conditions for 1) a current cycle, and 2) a user defined number of cycles before returning to normal adaptve operations.	4.9.0-1.0-5 · Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states.						Desirable
2.1.2.0-10	The ASCT shall assign unused time from a preceding phase that terminates early to a user-specified phase as follows: 〈 next phase; 〈 next coordinated phase; 〈 user-specified phase.	4.9.0-1.0-10 · Allow the operator to specify which phase receives unused time from a preceding phase						Desirable
2.1.2.0-11	The ASCT shall assign unused time from a preceding phase that is skipped to a user-specified phase as follows: 〈 previous phase; 〈 next phase; 〈 next coordinated phase; 〈 user-specified phase.	4.9.0-1.0-10 · Allow the operator to specify which phase receives unused time from a preceding phase						Desirable
2.1.2.0-12	The ASCT shall not alter the order of phases at a user-specified intersection.	4.1.0-7 The system operator needs to fix the sequence of phases at any specified location. For example, the operator may need to fix the phase order at a diamond interchange.						Desirable

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2.1.2.0-13	The ASCT shall not prevent repeat phases or phase reservices	3.6.2.0-1						Desirable
2.1.2.0-14	The ASCT shall not prevent variable phase sequencing							Desirable
2.1.2.0-15	The ASCT shall not prevent detector switching							Desirable
2.1.2.0-16	The ASCT shall not prevent early release of hold phases							Desirable
2.1.2.0-17	The ASCT shall not prevent late phase introduction							Desirable
2.1.2.0-18	The ASCT shall not prevent Stop-in-Walk	The system operator shall have the ability to use these features in failback operations should the ASCT fail.						Desirable
2.1.2.0-19	The ASCT shall not prevent Dynamic Max.							Desirable
2.1.2.0-20	The ASCT shall not prevent Floating Force Offs							Desirable
2.1.2.0-21	The ASCT shall not prevent offset correction transition features							Desirable
2.1.2.0-22	The ASCT shall not prevent user-selected fixing of phases sequencing at user-selected locations							Desirable
2.1.2.0-23	The ASCT shall prevent user-selected phases from being skipped under user-defined traffic conditions							Desirable

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2.1.3	**2.1.3 Oversaturation**							
2.1.3.0-1	The ASCT shall detect the presence of queues at pre-configured locations.	4.1.0-1.0-4 · Manage the lengths of queues						Desirable
2.1.3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	4.1.0-1.0-4 Manage the length of queues at user specified freeway ramp locations. In the event that queues exceed a user specified length, the system will serve the impacted phase to clear the queue before returning to adaptive operations						Mandatory
2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	4.1.0-1.0-4 · Manage the lengths of queues						Desirable
2.1.3.0-5	The ASCT shall meter traffic into user-specified bottlenecks by storing queues at user-specified locations.	4.1.0-1.0-4 · Manage the lengths of queues						Desirable
2.1.3.0-6	The ASCT shall store queues at user-specified locations.	4.1.0-1.0-4 · Manage the lengths of queues						Desirable
2.2	**2.2 Sequence-based Adaptive Coordination**							
2.2.0-3	**(Sequence-based only)** The ASCT shall calculate phase lengths for all phases at each signal controller to suit the current coordination strategy .	4.1.0-1.0-3 · Distribute phase times in an equitable fashion						Desirable
2.2.0-4	**(Sequence-based only)** The ASCT shall calculate offsets to suit the current coordination strategy for the user-specified reference point for each signal controller along a coordinated route within a group.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.2.0-4.0-1	**(Sequence-based only)** The ASCT shall apply offsets for the user-specified reference point of each signal controller along a coordinated route.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.2.0-5	**(Sequence-based only)** The ASCT shall calculate a cycle length for each cycle based on its optimization objectives (as required elsewhere, e.g., progression, queue management, equitable distribution of green).	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable

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2.2.0-5.0-2	**(Sequence-based only)** The ASCT shall limit cycle lengths to a user-specified range.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Mandatory
2.2.0-5.0-3	**(Sequence-based only)** The ASCT shall calculate optimum cycle length according to the user-specified coordination strategy.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.2.0-5.0-4	**(Sequence-based only)** The ASCT shall limit changes in cycle length to not exceed a user-specified value.	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Mandatory
2.2.0-5.0-5	**(Sequence-based only)** The ASCT shall adjust offsets to minimize the chance of stopping vehicles approaching a signal that have been served by a user-specified phase at an upstream signal.	4.1.0-5 The system operator needs to minimize the chance that a queue forms at a specified location.						Desirable
2.3	**2.3 Non-sequence-based adaptive coordination**							
2.3.0-2	**(Non-sequence-based only)** The ASCT shall calculate the appropriate state of the signal to suit the current coordination strategy at the critical signal controller. (A critical signal controller is defined by the user.)	4.1.0-1.0-1 · Maximize the throughput on coordinated routes						Desirable
2.3.0-5	**(Non-sequence-based only)** The ASCT shall adjust signal timing so that vehicles approaching a signal that have been served during a user-specified phase at an upstream signal do not stop.	4.1.0-5 The system operator needs to minimize the chance that a queue forms at a specified location.						Desirable
2.4	**2.4 Single intersection adaptive operation**							
2.4.0-2	The ASCT shall calculate a cycle length of a single intersection, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	4.1.0-1.0-6 · At an isolated intersection, optimize operation with a minimum of phase failures (based on the optimization objectives).						Desirable
2.4.0-3	The ASCT shall calculate optimum phase lengths, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	4.1.0-1.0-3 · Distribute phase times in an equitable fashion						Desirable
2.4.0-3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	4.1.0-1.0-3 · Distribute phase times in an equitable fashion						Desirable

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2.4.0-4	The ASCT shall calculate phase order, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	4.1.0-1.0-6 · At an isolated intersection, optimize operation with a minimum of phase failures (based on the optimization objectives).						Desirable
2.5	**2.5 Phase-based adaptive coordination**							
2.5.0-5	**(Phase-based only)** The ASCT shall alter the operation of the non-critical intersections to minimize stopping of traffic released from user-specified phases at the user-specified critical intersection.	4.1.0-2 The system operator needs to manage the coordination in small groups of signals to link phase service at some intersections with phase service at adjacent intersections. ***Note that phase-based systems do not explicitly calculate cycle, offset and split at all intersections.***						Desirable
2.5.0-6	**(Phase-based only)** The ASCT shall alter the operation of the non-critical intersections to minimize stopping of traffic arriving at user-specified phases at the user-specified critical intersection.	4.1.0-2 The system operator needs to manage the coordination in small groups of signals to link phase service at some intersections with phase service at adjacent intersections. ***Note that phase-based systems do not explicitly calculate cycle, offset and split at all intersections.***						Desirable
2.5.0-7	**(Phase-based only)** The ASCT shall adjust the state of the signal controller so that vehicles approaching a signal that have been served during a user-specified phase at an upstream signal do not stop.	4.1.0-5 The system operator needs to minimize the chance that a queue forms at a specified location.						Desirable
		4.1.0-2 The system operator needs to manage the coordination in small groups of signals to link phase service at some intersections with phase service at adjacent intersections.						Desirable
2.6	**2.6 Responsiveness**							
2.6.0-1	The ASCT shall limit the change in consecutive cycle lengths to be less than a user-specified value.	4.8.0-1 The system operator needs to modify the ASCT operation to closely follow changes in traffic conditions.						Mandatory

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3	**3 External/Internal Interfaces**							
3.0-1.0-1	The ASCT shall send operational data to the following external systems: City of Lynnwood TMC City of Mountlake Terrace City of Edmonds WSDOT Community Transit University of Washington STAR Lab	4.3.0-2 The system operator needs to send data to another system that would allow the other system to coordinate with the ASCT system. 4.11.0-5 The system operator needs to report performance data in real time to the agencies identified in the system requirements.						Desirable
3.0-1.0-3	The ASCT shall send monitoring data to the the following external systems: City of Lynnwood TMC Community Transit WSDOT City of Edmonds City of Mountlake Terrace	4.11.0-1 The system operator needs the locations identified to be able to monitor the ASCT system automatically.						Mandatory
3.0-1.0-5	The ASCT shall send performance data to the following external systems: City of Lynnwood TMC City of Edmonds City of Mountlake Terrace WSDOT Community Transit University of Washington STAR Lab	4.11.0-5 The system operator needs to report performance data in real time to the agencies identified in the system requirements.						Mandatory
4	**4 Crossing Arterials and Boundaries**							
4.0-1.0-4	The ASCT shall support adaptive coordination on crossing routes.	4.3.0-3 The system operator needs to adaptively coordinate signals on two crossing routes simultaneously. (Include signals on crossing arterials within the boundaries of the adaptive systems mapped in Chapter 3.)						Mandatory

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5	**5 Access and Security**							
5.0-1	The ASCT shall be implemented with a security policy that addresses the following selected elements:	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-1	〈 Local access to the ASCT.	The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory
5.0-1.0-2	〈 Remote access to the ASCT.	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-3	〈 System monitoring.	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-4	〈 System manual override.	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory

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5.0-1.0-5	〈 Development	The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-6	〈 Operations	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-7	〈 User login	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory
5.0-1.0-8	〈 User password	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory
5.0-1.0-9	〈 Administration of the system	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable

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5.0-1.0-10	〈 Signal controller group access	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-11	〈 Access to classes of equipment	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-12	〈 Access to equipment by jurisdiction	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory
5.0-1.0-13	〈 Output activation	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable

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5.0-1.0-14	〈 System parameters	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-15	〈 Report generation	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Mandatory
5.0-1.0-16	〈 Configuration	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-17	〈 Security alerts	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable

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5.0-1.0-18	〈 Security logging	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-19	〈 Security reporting	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-20	〈 Database	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable
5.0-1.0-21	〈 Signal controller	4.4.0-1 The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.						Desirable

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5.0-2	The ASCT shall provide monitoring and control access at the following locations:	4.10.0-1 The system operator needs to monitor and control all required features of adaptive operation at the identified locations: City of Lynnwood TMC, Maintenance Facility, City of Edmonds TMC, local controller cabinets, remote locations (through VPN into City's traffic signal system network), City of Mountlake Terrace TMC.						Mandatory
5.0-2.0-1	〈 City of Lynnwood TMC	4.10.0-1.0-1 · Agency TMC						Mandatory
5.0-2.0-2	〈 City of Lynnwood Maintenance facility	4.10.0-1.0-2 · Maintenance facility						Mandatory
5.0-2.0-4	〈 City of Edmonds	4.10.0-1.0-4 · Other agency's TMC						Mandatory
5.0-2.0-5	〈 Local controller cabinets	4.10.0-1.0-5 · Local controller cabinets						Mandatory
5.0-2.0-7	〈 Through VPN into City's traffic signal system network	4.10.0-1.0-7 · Remote locations						Mandatory
5.0-2.0-8	〈 City of Mountlake Terrace	4.10.0-1.0-4 · Other agency's TMC						Mandatory
5.0-4	The ASCT shall not prevent access to the local signal controller database, monitoring or reporting functions by any installed signal management system.	4.10.0-2 The operator needs to access to the database management, monitoring and reporting features and functions of the signal controllers and any related signal management system from the access points defined for those system components.						Mandatory
6	**6 Data Log**							
6.0-1	The ASCT shall log or allow an installed signal management system to log the following events:	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-1	Time-stamped vehicle phase calls	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-2	Time-stamped pedestrian phase calls	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory

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6.0-1.0-3	Time-stamped emergency vehicle preemption calls	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-4	Time-stamped transit priority calls	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-6	Time-stamped start and end of each phase	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-7	Time-stamped controller interval changes	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-1.0-8	Time-stamped start and end of each transition to a new timing plan	4.11.0-6 The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.						Mandatory
6.0-2	The ASCT shall export its systems log in the following formats: 〈 MS Excel 〈 Text 〈 CSV	4.11.0-4 The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the formats specified in the system requirements.						Mandatory
6.0-3	The ASCT shall store the event log for a minimum of 90 days	4.11.0-4 The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the formats specified in the system requirements.						Mandatory

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6.0-4	The ASCT shall store results of all signal timing parameter calculations for a minimum of 90 days.	4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. 4.11.0-3 The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.						Desirable
6.0-5	The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a minimum of 90 days: 〈 volume 〈 occupancy 〈 queue length 〈 phase utilization 〈 arrivals in green 〈 green band efficiency	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. 4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. 4.11.0-3 The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.						Desirable
6.0-6	The ASCT system shall archive all data automatically after a user-specified period not less than 90 days.	4.11.0-4 The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the formats identified in the system requirements.						Desirable
6.0-7	The ASCT shall provide data storage for a system size of 75 signal controllers. The data to be stored shall include the following: 〈 Controller state data 〈 Reports 〈 Log data 〈 Security data 〈 ASCT parameters 〈 Detector status data	4.11.0-4 The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the formats identified in the system requirements.						Desirable
	The ASCT shall calculate and report relative data quality including:	4.11.0-7						

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6.0-8	〈 The extent data is affected by detector faults	Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
6.0-9	The ASCT shall report comparisons of logged data when requested by the user: 〈 Day to day, 〈 Hour to hour 〈 Hour of day to hour of day 〈 Hour of week to hour of week 〈 day of week to day week * Day of year to day of year	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
6.0-10	The ASCT shall store data logs in a Excel and CVS format	4.11.0-4 The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the formats identified in the system requirements.						Desirable
6.0-12	The ASCT shall store the following data in 5 minute increments: 〈 volume 〈 occupancy 〈 queue length	4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. 4.11.0-3 The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.						Desirable
7	**7 Advanced Controller Operation**							
7.0-1	When specified by the user, the ASCT shall serve a vehicle phase more than once for each time the coordinated phase is served.	4.9.0-1.0-1 Service a phase more than once per cycle						Desirable
7.0-2	The ASCT shall provide a minimum of 4 phase overlaps.	4.9.0-1.0-2 Operate at least 4 overlap phases						Mandatory
7.0-3	The ASCT shall accommodate a minimum of 16 phases at each signal	4.9.0-1.0-3 Operate four rings, 16 phases and up to four phases per ring.						Mandatory
7.0-4	The ASCT shall accommodate a minimum of 4 rings at each signal.	4.9.0-1.0-3 Operate four rings, 16 phases and up to four phases per ring.						Mandatory

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7.0-5	The ASCT shall accommodate a minimum of 4 phases per ring	4.9.0-1.0-3 Operate four rings, 16 phases and up to four phases per ring.						Mandatory
7.0-7	The ASCT shall not prevent a phase/overlap output by time-of-day.	4.1.0-6 The system operator needs to modify the sequence of phases to support the various operational strategies.						Desirable
7.0-9	The ASCT shall enable all phases to be designated as coordinated phases.	4.1.0-6 The system operator needs to modify the sequence of phases to support the various operational strategies. 4.9.0-1.0-9 Allow any phase to be designated as the coordinated phase						Mandatory
7.0-11	The ASCT shall not prevent the controller from displaying flashing yellow arrow left turn.	4.9.0-1.0-15 Use flashing yellow arrow to control permissive left turns and right turns.						Mandatory
7.0-11.0-1	The ASCT shall have the ability to hold a flashing yellow arrow until a conflicting pedestrian movement is cleared.							Desirable
7.0-11.0-2	The ASCT shall have the ability to hold a flashing yellow arrow until adequate gaps in traffic are detected.							Desirable
7.0-11.0-3	The ASCT shall have the ability to switch from flashing yellow arrow to protected only operations based on volume inputs.							Desirable
7.0-12.0-1	The ASCT shall operate adaptively using user-specified detector channels to allow the controller to respond independently to individual lanes of an approach.	4.9.0-1.0-11 Allow the controller to respond independently to individual lanes of an approach. This may be implemented in the signal controller using extension/passage timers, which may be assignable to each vehicle detector input channel. This may allow the adaptive operation to be based on data from a specific detector, or by excluding specific detectors.						Desirable
7.0-16	The ASCT shall accommodate a minimum of 64 detectors.	4.9.0-1.0-12 Ability to have up to 64 detectors.						Mandatory

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8	**8 Pedestrians**							
8.0-2	When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times during adaptive operations.	4.6.0-2 The system operator needs to accommodate infrequent pedestrian operation while maintaining adaptive operation. (This is appropriate for pedestrian calls that are common but not so frequent that they drive the operational needs.) 4.6.0-3 The system operator needs to incorporate frequent pedestrian operation into routine adaptive operation. (This is appropriate when pedestrians are frequent enough that they must be assumed to be present every cycle or nearly every cycle.)						Mandatory
8.0-9	The ASCT shall not inhibit negative vehicle and pedestrian phase timing.	4.9.0-1.0-17 Use negative pedestrian phasing to prevent an overlap conflicting with a pedestrian walk/don't walk						Desirable
10	**10 Detection**							
10.0-1	The ASCT shall be compatible with the following detector technologies: Video Detection Loop Detection	4.15.0-1.0-2 The system operator is constrained to use existing Flir-Traficon video detection cameras and inductance loops. - See Concept of Operations for installation location.						Mandatory
11	**11 Railroad EV Preemption**							
11.0-2	The ASCT shall maintain adaptive operation at non-preempted intersections during emergency vehicle preemption.	4.13.0-2 The system operator needs to accommodate emergency vehicle preemption by returning to the System Operator defined optimization strategy as efficiently as possible following a preempt.						Desirable

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11.0-4	The ASCT shall resume adaptive control of signal controllers when preemptions are released.	4.13.0-2 The system operator needs to accommodate emergency vehicle preemption by returning to the System Operator defined optimization strategy as efficiently as possible following a preempt.						Mandatory
12	**12 Transit Priority**							
12.0-1	The ASCT shall continue adaptive operations of a group when one of its signal controllers has a transit priority call.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-2	The ASCT shall advance the start of a user-specified green phase in response to a transit priority call.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-2.0-1	The advance of start of green phase shall be user-defined.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-2.0-2	Adaptive operations shall continue during the advance of the start of green phase.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-3	The ASCT shall delay the end of a green phase, in response to a priority call.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory

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12.0-3.0-1	The delay of end of green phase shall be user-defined.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-3.0-2	Adaptive operations shall continue during the delay of the end of green phase.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-4	The ASCT shall permit at least 4 exclusive transit phases.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-4.0-1	Adaptive operations shall continue when there is an exclusive transit phase call.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Desirable
12.0-5	The ASCT shall control vehicle phases independently of the following:	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Desirable
12.0-5.0-2	〈 Bus only phases	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Desirable
12.0-8	The ASCT shall accept a transit priority call from: 〈 a signal controller/transit vehicle detector; 〈 an external system.	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Mandatory
12.0-9	The ASCT shall use an estimated transit arrival time value to determine whether priority is need and if so, if an early green or green extension shall be provided	4.13.0-3 The system operator needs to accommodate bus transit signal priority while maintaining adaptive operations at an intersection or on a corridor.						Desirable

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13	**13 Failure Events and Fallback**							
13.1	**13.1 Detector Failure**							
13.1.0-1	The ASCT shall take user-specified action in the absence of valid detector data from one or more vehicle detectors within a group.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.1.0-1.0-2	The ASCT shall release control to local operations to operate under its own time-of-day schedule.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.1.0-2	The ASCT shall use the following alternate data sources for operations in the absence of the real-time data from a detector:	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable
13.1.0-2.0-1	〈 Data from a user-specified alternate detector.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable
13.1.0-2.0-2	〈 Stored historical data from the failed detector.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable
13.1.0-3	In the event of a detector failure, the ASCT shall issue an alarm to maintenance and operations staff.	4.12.0-1 The system operator needs to immediately notify maintenance and operations staff of alarms and alerts. 4.12.0-2 The system operator needs to immediately and automatically pass alarms and alerts to maintenance and operations staff.						Desirable
13.1.0-4	In the event of a failure, the ASCT shall log details of the failure in a permanent log.	4.12.0-3 The system operator needs to maintain a complete log of alarms and failure events.						Desirable

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13.1.0-5	The permanent failure log shall be searchable, archivable and exportable.	4.12.0-3 The system operator needs to maintain a complete log of alarms and failure events.						Desirable
13.2	**13.2 Communications Failure**							
13.2-1	The ASCT shall execute user-specified actions when communications to one or more signal controllers fails within a group.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.2-1.0-2	The ASCT shall switch to the alternate operation in real time without operator intervention.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.2-1.0-2.0-1	The ASCT shall revert to time-of-day operations, or							
13.2-1.0-2.0-2	The ASCT shall revert to free operation							
13.2-2	In the event of communications failure, the ASCT shall issue an alarm to maintenance and operations staff	4.12.0-1 The system operator needs to immediately notify maintenance and operations staff of alarms and alerts. 4.12.0-2 The system operator needs to immediately and automatically pass alarms and alerts to maintenance and operations staff.						Mandatory
13.2-3	The ASCT shall issue an alarm within 5 minutes of detection of a failure.	4.12.0-1 The system operator needs to immediately notify maintenance and operations staff of alarms and alerts. 4.12.0-2 The system operator needs to immediately and automatically pass alarms and alerts to maintenance and operations staff.						Mandatory
13.2-4	In the event of a communications failure, the ASCT shall log details of the failure in a permanent log.	4.12.0-3 The system operator needs to maintain a complete log of alarms and failure events.						Desirable
13.2-5	The permanent failure log shall be searchable, archivable and exportable.	4.12.0-3 The system operator needs to maintain a complete log of alarms and failure events.						Desirable

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13.3	**13.3 Adaptive Processor Failure**							
13.3-1	The ASCT shall execute user-specified actions when adaptive control fails.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.3-1.0-2	The ASCT shall release control to local operations to operate under its own time-of-day schedule.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Mandatory
13.3-2	In the event of adaptive processor failure, the ASCT shall issue an alarm to maintenance and operations staff	4.12.0-1 The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.						Mandatory
13.3-3	The permanent failure log shall be searchable, archivable and exportable.	The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.						Desirable
13.3-4	During adaptive processor failure, the ASCT shall provide all local detector inputs to the local controller.	4.14.0-1 The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.						Desirable
14	**14 Software**							
14.0-1	The vendor's adaptive software shall be fully operational within the following platform: 〈 Windows-PC, Windows-Server)	4.15.0-2 The system operator needs to use equipment and software acceptable under current agency IT policies and procedures.						Mandatory
14.0-2	The ASCT shall fully satisfy all requirements without limitations when using existing Flir-Traficon video detection and inductance loops installed in their existing locations.	4.15.0-1.0-2 The system operator is constrained to use existing Flir-Traficon video detection cameras and inductance loops. - See Concept of Operations for installation location.						Mandatory
14.0-3	The ASCT shall fully satisfy all requirements without limitations when connected with Naztec 2070 controllers running the Apogee software.	4.15.0-1.0-1 The system operator is constrained to use the Naztec 2070 controller running the Apogee software.						Mandatory
14.0-4	The ASCT shall communicate with central over an Ethernet over fiber network.	4.15.0-1.0-3 The system operator needs to use the existing Ethernet over fiber communication system.						Mandatory

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14.0-5	The ASCT must allow performance monitoring of traffic signals use the existing ATMS.now central system	Central signal system type (ATMS.now)						Mandatory
15	**15 Training**							
15.0-1	The vendor shall provide the following training:	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Desirable
15.0-1.0-1	The vendor shall provide training on the operations of the adaptive system.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-2	The vendor shall provide training on troubleshooting the system.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-3	The vendor shall provide training on preventive maintenance and repair of equipment.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-4	The vendor shall provide training on system configuration.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-5	The vendor shall provide training on administration of the system.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-6	The vendor shall provide training on system calibration.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-7	The vendor's training delivery shall include: printed course materials and references, electronic copies of presentations and references.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Desirable
15.0-1.0-8	The vendor's training shall be delivered at the City of Lynnwood.	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Mandatory
15.0-1.0-10	The vendor shall provide two days of training before the system is deployed and additional two days of follow up training three - six months after the system has been in full operations	4.16.0-1 The agency needs all staff involved in operation and maintenance to receive appropriate training.						Desirable

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16	**16 Maintenance, Support and Warranty**							
16.0-1	The Maintenance Vendor shall provide maintenance according to a separate maintenance contract. That contract should identify repairs necessary to preserve requirements fulfillment, responsiveness in effecting those repairs, and all requirements on the maintenance provider while performing the repairs.	4.16.0-2 The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to be maintained to repair faults that are not defects in materials and workmanship.						Desirable
16.0-2	The Vendor shall provide routine updates to the software and software environment necessary to preserve the fulfillment of requirements for the time period noted in the RFP. Preservation of requirements fulfillment especially includes all IT management requirements as previously identified.	4.16.0-4 The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs support to keep software and software environment updated as necessary to prevent requirements no longer being fulfilled.						Desirable
16.0-3	The Vendor shall warrant the system to be free of defects in materials and workmanship for a period noted in the RFP. Warranty is defined as correcting defects in materials and workmanship (subject to other language included in the purchase documents). Defect is defined as any circumstance in which the material does not perform according to its specification.	4.16.0-3 The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to remain free of defects in materials and workmanship that result in requirements no longer being fulfilled.						Desirable
17	**17 Schedule**							
17.0-1	The ASCT shall set the state of external input/output states according to a time-of-day schedule.	4.17.0-1 The system operator needs to be able to turn on signs that control traffic or provide driver information when specific traffic conditions occur, when needed to support the adaptive operation, when congestion is detected at critical locations or according to a time-of-day schedule						Desirable
18	**18 Performance Measurement, Monitoring and Reporting**							
18.0-1	The ASCT shall report measures of current traffic conditions on which it bases signal state alterations.	4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.						Desirable

Requirements Reference Number	ASCT System Requirements	Need Statement (#.## Represents Relevant Concept of Operations Section)	Meets Requirements	Partially Meets Requirements	Requirement in Development	Requirement Not Available	Briefly discuss how requirement is met and if partially met or in development, how it could be met before the City of Lynnwood Verification	Desirable/ Mandatory
18.0-2	The ASCT shall report all intermediate calculated values that are affected by calibration parameters.	4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.						Desirable
18.0-3	The ASCT shall maintain a log of all signal state alterations directed by the ASCT.	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. 4.11.0-2 The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.						Desirable
18.0-3.0-1	The ASCT log shall include all events directed by the external inputs.	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
18.0-3.0-2	The ASCT log shall include all external output state changes.	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
18.0-3.0-3	The ASCT log shall include all actual parameter values that are subject to user-specified values.	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
18.0-3.0-4	The ASCT shall maintain the records in this ASCT log of a minimum of 90 days.	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable
18.0-3.0-5	The ASCT shall archive the ASCT log after 90 days	4.11.0-7 Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.						Desirable